I *An Experiment made before the Preſident and Fellows of the Royal Society, in which a ſurprizing change of Colour from a pale Tranſparent or Clear Liquor, to a very Blue Cerulcous one was exhibited, and that in an inſtant, by the admiſſion of Air only: Apply'd to illuſtrate ſome changes of Colour, and other Effects on the Blood of Reſpiring Animals.* By Fr. Slare, M. D. *Fellow of* R. S. *and Cenſor of the Colledge of Phyſicians.*

IN order to the making of this Experiment, the Operator ſhould furniſh himſelf with a quantity of Filings of Copper freſh made, and place them in a Glaſs Vial, whoſe bottom is broad and even, and then pour on a Urinous Spirit, either of *Sal Armoniac*, or of Urine it ſelf, not made with Quick-Lime: The Glaſs ſhould not be fill'd up much above one half-way, and then muſt preſently be ſo exactly ſtopt that no Air be capable of intruding; for if you err in a Circumſtance the Experiment will not ſucceed. The Foundation of this Experiment is juſtly due to the Immortal Mr. *Boyle*, but our Aims are very differing in the Application, as well as in the manner of preparing and exhibiting the Experiment. He was ſearching after ſome hidden proprieties of the Air, and particularly apply'd it to the broken or leſſen'd Spring of the Air, which this *Phænomenon* afforded his Speculation. But I have endeavour'd to bring it home to my own Profeſſion, to juſtifie a Notion of ſome Importance, tho' much diſputed, concerning an alteration made by the Air upon Humane Blood, both as to Colour,

lour, and other Vertues. You have alſo this difference in the manner of exhibiting, in Mr. *Boyle*'s Experiment you have the Fileings of Copper contiguous with your *Menſtruum*, in ours you have a clear Colourleſs Liquor, and no Materials at all in your Glaſs to give the leaſt Umbrage to this ſudden change of Colour; but this cannot be performed without ſome *Encheireſis* and an *Apparatus* extraordinary.

'In making the Experiment you will obſerve, for 'four, five, or ſix days the Tincture will be growing 'deeper and deeper, and then will keep a ſtand for two 'or three days more or leſs, and afterwards will gradual-'ly decline until it become quite pale, and void of all 'Colour. When it is in this ſtate, the eaſieſt way of 'performing the Experiment for your own ſatisfaction, 'is to decant this clear Spirit into a Glaſs ſo as to leave 'all the Fileings behind, and that will demonſtrate that 'the Fileings did not give this Tincture *de novo*, but that 'it belongs to the influence of the Air. But in caſe you 'are furniſh'd with an Air-pump, and can pour off this 'palid Liquor in a *Vacuo Aeris*, and there ſtop it up ſe-'curely, you may then preſerve it ſo long as you pleaſe, 'and exhibit it to advantage, which is the way I com-'monly uſe. You may alſo obſerve, that ſo ſoon as 'you let in the Air, the upper Superficies immediately 'tinges firſt, and ſo deſcends deeper and deeper until it 'has penetrated the whole, and this it does the ſooner, if 'the Glaſs be wide, and the Liquor by conſequence have 'a large Superficies: Or if you pour it out of one Glaſs 'into another, the Air makes a more ſudden change of 'the whole.

That Liquors ſhould loſe their Tinctures is not to be wonder'd at, for even Ink it ſelf by ſtanding ſtill will loſe much of its Tincture, and ſo do the Tinctures of many Minerals, Tincture of Sulphur, and of Salt of Tartar will loſe their Tinctures, and many Vegetables are not

long

long to be preſerved, but do grow turbid, ſome pale, and colourleſs, and leave their *Menſtruums*, and precipitate to the bottom, and are not eaſily if ever recover'd. But in our Experiment we have ſome things very uncommon, a deeply ting'd Liquor grows pale and colourleſs in a few days, without any admiſſion of Air or any other Ingredient to diſturb it, or to cauſe any diſcernable precipitation or ſeparation. Yet when I conſider that two Grains of Copper will give a deep Colour to three Ounces of Urinous Spirits, we need not expect any great quantity ſhould be diſcharg'd out of the Liquor to be very conſpicuous at the bottom, which does better ſolve it than a bare change of Texture can do; namely, to allow it to ſubſide to the bottom of the Glaſs, tho' it be ſcarce perceptible by reaſon of the Fileings that may conceal it. But a yet greater difficulty emerges to account for, which is, That ſince our *Menſtruum*, (that is, our Spirit) is diveſted of its Venereal Particles, which gave the Tincture, and is become as clear as Rock-water, and being ſeparated from its Metalline Fileings, does yet upon the approach of the Air immediately afford a very Blue Tincture. This indeed plainly ſhews, that there muſt be conceal'd in the Pores of the Liquor, ſuch Particles as are of a Cupreous Nature. But how may this come to paſs? To which I anſwer, I cannot be ſo vain to think, that the Air gives the matter of the Colour to the Spirit, but that it conveys into it ſuch Particles as do ſtimulate and give motion to the *Menſtruum*, and inable it to diſſolve thoſe Particles thoroughly, that for want of more Air had not been fully broken in pieces.

In the next place, I diſcover two very differing ſorts of Matter that our Urinous *Menſtruum* acts upon in this Experiment. One I call a Sulphureous Matter, which gives the Blue Colour, and does let it fall again; and another which deſerves the name of Saline; but tho' it be taken up into our tinging Spirit, does yet notwithſtanding

ſtanding afford no Tincture whilſt ſecluded from the Air: This was made to me very plain and clear, for having found out a way to ſeparate a white ſlimy ſubſtance out of our clear Liquor, I then deſtroy'd the Experiment, ſo that when expos'd to the Air the *Menſtruum* would no more give the leaſt Tincture: For a farther confirmation, this white Saline Subſtance being in a ſmall quantity diſſolved in any proper Urinary *Menſtruum* exhibits the Experiment ſet down to advantage, and gives a much finer and brighter Colour than what is drawn from Crude Copper, or from the Sulphureous parts: But ſince the method above is more feaſible, I will not ſpend time for fear of diſcouraging the Undertaker of an Experiment, to ſet down this very elaborate method of procuring the Salt of *Venus*.

The great Intereſt the Air has in this Experiment made me think of applying it to the great change that is made upon Blood; for it is obvious to every Body that there is a great difference in Colour betwixt the Venal and Arterial Blood, the Venal ſo ſoon as it is let out of the Vein is obſerved to be of a dark Complexion, and requires ſome time to be expos'd to the Air before it obtains a florid Red, and that only Superficies which is contiguous to the Air, does for a good while become Red; for I have turn'd up a Cake of Blood twenty four hours after it had been let out, and found it of a very dark and opake Colour, but the Air has immediately given it a bright and florid Red Tincture. This ſo manifeſt a change made by vertue of the Air is obvious even *Lippis & Tonſoribus*, which would make one wonder to find great Philoſophers and Anatomiſts endeavour to aſſign more forreign and ambiguous Cauſes of ſo demonſtrable an effect of the Air. Thus our Famous Anatomiſts Dr. *Highmore*, and Dr. *Needham*, and others, have adventur'd to do; who would have reſpiration to be chiefly to promote the Circulation of the Blood, and that

great *Apparatus* of Air-Veſſels to be for a Fan to cool the Maſs of Blood, and that the Air returns unalter'd, and not capable of making any great alteration, being denied any ingreſs into or mixture with the Blood. The Obſervation is certain and unerring, that the Venal Blood as it paſſes the Right Ventricle at its entrance into the Lungs is of a very opake and blackiſh Complexion, and in its paſſage through the Lungs before it comes to the Left Auricle, is changed into a very florid and bright Red. I have often obſerved that Perſons that have Vomited Blood upon a Rupture of ſome Capillary Veſſels of the Lungs, have ſent up a very froathy or ſpumous Blood, and at the ſame time of a bright Scarlet Red: That it was froathy, argues that the Air had incorporated with it; that it was Red was due to the tingeing power of the Air. To expect that this change ſhould be made in the Heart by any Local Ferment, or *flamma vitalis* is fruitleſs; becauſe we find it performed before its arrival there; the ſtructure of the Heart denoting that Engine to be principally made for projecting the Blood in order to a Circulation through thoſe various Arteries or Pipes which are branched from the Heart. Let us therefore examine the ſtructure of the Lungs, and very briefly conſider them, we ſhall ſoon diſcover it to be a Pneumatic Engine made principally for taking in Air, and that in great quantities, which a Remark in the Fourth Corollary does much favour. It's true, we may call the Lungs a Contexture of Veins, Arteries, Nerves, Lymphæducts, *&c.* and that theſe do very much make up the Parenchyma (as ſome do uſe the word) of the Lungs; but yet we ſhall find the great bulk of the Lungs to be Veſicular: It ſeems to me to be a Continuation of the *Aſpera Arteria*, or Wind-pipe, divided and ſubdivided into many Branches, and theſe ſtill ſpun out into leſſer and leſſer Pipes, all of them hollow; the farther they run the thinner their ſides do grow, which

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upon the Inſpiration of Air do ſwell up and grow round, and upon expiration do fall ſomething flaccid, and abate ſomething of that Figure, as the Microſcope does plainly repreſent. That theſe Pipes ſhould run to a great length hollow, tho' very ſmall, I the leſs wonder at, having ſeen a hollow Pipe of Glaſs drawn out at the flame of a Lamp ſo very ſmall as to be ſcarce viſible without a Microſcope, and yet was ſo hollow as to take up tinged Spirit of Wine, where only the ordinary preſſure of the Ambient Air impell'd it. Nor will compreſs'd Air be kept out where there is the leaſt Pore left open, which makes it more than probable that it ſhould inſinuate into this Machine, ſo truly adapted to receive the Air, and that in great quantity, the *Apparatus* of Air-Veſſels being ſo very conſiderable, which appears in each inſpiration; for the Luugs are ſtretch'd at that rate as to take up double the room they do in the ſtate of expiration, or in their compreſs'd ſtate; and even in this ſtate the Air-bladders are not fully evacuated, but contain Air for good purpoſes. Nor can it be pretended that any augmentation is due to the Expanſion of the Blood-Veſſels, or any other which do not ſwell beyond their uſual Tenſion in each inſpiration. The Sanguiferous Veſſels are divaricated through all the Lobes of the Lungs, and do give a very cloſe attendance to each *Veſicula* (for there is not the leaſt *Veſicula* but has a Capillary Veſſel which intimately inſinuates into it) in order to receive ſome conſiderable benefit from it; and this appears to the Eye, for in an inſtant a dark and foul Blood is changed into a bright florid Red Colour, which would make a Man of Contemplation to admire it, and a Lover of Red Wine, who is preſently offended to ſee his Liquor foul, (and perhaps juſtly condemns it for unwholeſome) wiſh for ſuch another expedient to clear up his turbid Liquor. Thus the very ſtructure of the Lungs, the effect of change of Colour both in the Blood and in our

Experiment, the one from a dark opake Colour to a noble Scarlet Dye; the other from a pale or colourleſs Liquor to a rich *Ultra Marine* Blue, do all combine to do juſtice to the Air for this celebrated alteration. Nor is the Air thus infûs'd into the Lungs for a bare Colour, and of no farther conſideration: But I am apt to believe the great Fermentations of the Blood the cauſe of the Motions and Actions of the Muſcles; the Animal Spirits themſelves, the great Spring of Motions, derive their Energy and Powers, if not Nature, from hence.

COROLLARY I.

The Air is full of Volatile Salts none will deny, but that theſe Salts muſt bear the name of Nitrous Salts, it has been ſcarce call'd in queſtion, which this Experiment and ſome others I have made, do. Nitrous Salts ſeem to me not to have any property of Volatile Salt: Nitre is a Salt of ſo fixed a nature, that it will continue melted in a very ſtrong Fire with ſcarce any Evaporation; but if you put into it Charcoal, or Brimſtone, or give it an Accenſion by another Eucheireſis you may obtain a great quantity of as fixed a Salt as any Concrete whatever affords; ſo that to me Gold ſeems not of a more fix'd Nature.

COROLLARY II.

A ſtandard of Volatile Salts ſhould be ſetled, at preſent I can think of none better than Water. That Salt which in Diſtillation is more fix'd than Water, ought not to be reckon'd amongſt Volatile Salts: This ſtandard will be juſtified by good meaſures, grounded on Experience; for all Salts that are truly Volatile, as far as I could obſerve, are really lighter than Water, that is in a Chymical ſenſe, do with a leſs degree of Fire ſublime

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in our Glaſſes, or come over the Helm, than Water does. This I find juſtified in our Volatile Salt of Amber erroneouſly ſo call'd, for it does not come up to our ſtandard of Volatility, and is really no Volatile Salt, as will be made appear: If you take this ſuppoſed Volatile Salt and Diſtil it in a Retort, or Head, and Body, with common Water, the Water will aſcend in ſuch a degree of Fire where the Salt will not, for you muſt increaſe your Fire conſiderably to make it riſe after the Water is gone, and has left the dry Salt at the bottom. This made me enquire farther into the properties of this Salt, which did not at all Correſpond with Volatile Salts (for all true Volatile Salts are Alkalies) but on the contrary would ferment with them, and quite deſtroy the property of true Volatile Salts, by bringing them to a dull inſipid Salt, which ſome call *Sal Neutrum*; and alſo by fixing their Volatile Nature, not only in putting them by the ſtandard of Volatility, but alſo does quite deſtroy their ſpiritous and ſtimulating ſmell, by vertue of which they have been always deſervedly eſteem'd ſuch excellent Cephalick Medicines. Therefore examining this Salt yet a little farther, you will plainly prove it to be an Acid, that Corrodes Iron, turns Syrup of July-flowers Green, deſtroys the Tincture of *Lignum Nephriticum*, and does not ferment with common Acids; ſo that it plainly belongs to the Tribe of Acids, and ſhould be ſtruck out of the Catalogue of Volatile Salts; and perhaps out of the number of Specific Cephalicks, and rather be degraded amongſt the Diureticks, and even in that rank to have but an inferior ſtation; for it ſeems to me to be but a dull Medicine, and more Valuable for its Price than great Vertue, eſpecially if quite diveſted of all its Oyl, in which the great *Cephalic* and Cordial Vertue muſt needs be own'd to conſiſt.

COROLLARY III.

That Volatile Salts have a great property to draw Tinctures, and do particularly advance thoſe Colours that are diſpos'd to be Red: For tho' Spirit of Wine be a very Catholic *Menſtruum*, and draws a very deep Tincture of Cochinel, yet we have often obſerved that if we put to this Tincture, when higheſt, a ſmall proportion of Volatile Salt that would advance it to a great, even a double degree. Thus I have obſerved it to advance the Tincture of Arterial Blood; and which is very Curious, if you diſſolve it in your Blood whilſt you are Bleeding at one of your Veins, that Blood will become very florid, and like Arterial Blood. Therefore ſince Nitrous Salts produce none of theſe tingeing Effects; this Corollary ſeems much to favour the Notion, That the Effects of the Air upon the Blood, may be due to ſuch Salts as are of a Volatile Alkaliſat Nature.

COROLLARY IV.

Contagious Diſeaſes are Communicated by the Air inſpired at the Lungs; and this ſeems more probable than what Dr. *Needham* and others, have endeavour'd to make out with more difficulty; in attributing the ſame effect to the Air taken in our Meat by Maſtication, and ſwallow'd down in our Drink, and communicated to our Chyle from thence to our Blood and Spirits; but this way a very ſmall quantity of infected Air is Communicated, if we compare it with what is Communicated to the Lungs: For in each inſpiration, Humane Lungs of an ordinary ſize do at leaſt take in ſuch a quantity of Air as will fill up a Quart Bottle, and in the ſpace of a Minute I have made Twelve Reſpirations, (when I was very ſedate, and drew in my Breath very treatably) and in

in that time by conſequence took in as much Air as would fill up a Veſſel capacious enough to hold three Gallons of Water; and it's plain that the Air expired returns much alter'd, for as much as the Breath or *Halitus* returns impregnated with a moiſt Vapour, and ſuch a one as does many times indicate the Temper of the Blood: From this *Halitus* Impoſthumations of the Lungs are frequently predicted: Such as have Sulphureous Blood ſhall emit no very pleaſing but rancid Exhalations: Nor does the Blood only clear it ſelf of ſome Vapours in expiration, but alſo imbibe, and impregnate it ſelf with ſuch Particles as are neceſſary to maintain Life in inſpiration; for a Man could not ſubſiſt long in a Tun of Air, ſhould he be kept cloſe in ſo capacious a Veſſel, as we have found by Experiments made with ſeveral reſpiring Animals, Dogs, Cats, and Birds, *&c.* that theſe would ſoon die there; ſo that we need conſtant ſupplies of vaſt quantities of freſh Air, which makes me believe that thoſe Particles ſeparated out of the Air by the Lungs are very ſparingly deliver'd or mix'd with the common Air, but yet with this difference, that the more compreſs'd the Air is, the more it contains of that vivifying Salt or Spirit, and the contrary, the more rarified the leſs is found; for we are told by the Experience of ſuch as have been on the Pike of *Teneriff*, that their breathing is more difficult there than at the bottom, where the Air is more compreſs'd. And we have found Birds and Mice, *&c.* would live as long again, in a Veſſel where we had crouded in, by a Syringe (or any other condenſing Engine) a double quantity of Air, as they did where they were confined only to common Air. To conclude, ſince the vivifying Particles in the Air ſeem to be very ſparingly diſſeminated through it, I am apt to believe that the Noxious and Peſtilential are more ſparingly ſcattered up and down; (the Author of Humane Nature having taken more

more care for its Preſervation than for its Deſtruction) and therefore it may much better be inferr'd from the Premiſes, That Contagious Diſeaſes muſt needs be communicated to the Blood by Inſpiration into the Lungs, rather than any other way.

II. *An Extract of a Letter from Dr.* William Oliver, *Communicated by* Walter Moyle, *Eſq;*

Torbay, *the* 15*th. of* July, 1693.

SIR,

WHen we Cruiſed in the Bay of *Biſcay*, *June* the 8*th*, and had a hundred Fathom of Water, we took a Quart Glaſs Bottle ſtopt with a large Cork, and after tyed down with a ſtrong Packthread, as we uſe to for Bottle Syder, or Ale, faſtening our Bottle to our Plumbing-rope, and with a Lead at the end, ſunk it to the bottom of the Sea, which as ſoon as we perceiv'd, we drew it up again, and found the Cork quite preſs'd thro' the neck of the Bottle into its cavity, and the Bottle full of Salt Sea-Water. We repeated our Experiment with another Bottle and Cork in the ſame manner as before, but the Cork being not ſound, the Sea-Water ſoak'd thro' it, and the Bottle was half full of Water, ſo the Cork remain'd in the mouth of the Bottle not preſs'd down at all. We repeated our Experiment a third time in ninety Fathom of Water, with a very ſound Cork, and much larger than the mouth of the Bottle, for we were forc'd to beat it in with a Hammer as far as it would go, leaving about an inch of the Cork above the mouth of the Bottle, and tyed down as before, but it ſucceeded not ſo well as at firſt, tho' the Cork was now preſs'd down into the neek, and became level with the mouth

Fig: 1

Fig: 2